

# FEEDING HABITS OF *MACROPIPUS TUBERCULATUS* (BRACHYURA, PORTUNIDAE) OFF THE CATALAN COAST (NW MEDITERRANEAN)

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*Feeding habits of Macropipus tuberculatus (Brachyura, Portunidae) off the Catalan coast (NW Mediterranean).*— *Macropipus tuberculatus* predaes opportunistically upon epifaunal crustaceans and small fish. Infaunal organisms such as echinoderms, polychaetes and bivalves constitute a smaller part of the diet. Pelagic shrimps are preyed upon during day-time hours while they are on the bottom. No significant differences in diet composition were found between the sexes. Recent post-moult individuals showed the highest proportion of empty foreguts. Advanced post-moult individuals showed the highest proportion of full foreguts. Seasonal differences in diet composition are attributed to parallel variation in prey availability, especially with respect to juvenile fish.

**Key words:** *Macropipus tuberculatus*, Brachyura, Portunidae, Feeding habits, Mediterranean.

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## INTRODUCTION

*Macropipus tuberculatus* (Roux) is a portunid crab that inhabits muddy areas on the deepest part of the continental shelf and on the upper slope along the eastern North Atlantic, from West Norway (CHRISTIANSEN, 1969) to Morocco and the Azores (MANNING & HOLTHUIS, 1981), including the Mediterranean (ZARIQUIEY-ÁLVAREZ, 1968). In the area of study (north-western Mediterranean), the species occurs at low densities at depths between 150 and 400 m (ABELLÓ et al., 1988), where it is often captured as a minor by-catch of the demersal fishery.

Feeding ecology in portunid crabs has been studied mainly in commercially important species (CAINE, 1974; HILL, 1976; GONZÁLEZ-GURRIARÁN, 1978; PAUL, 1981; WILLIAMS, 1982; LAUGHLIN, 1982). The study of the food habits of non-commercial crabs however is recently increasing, since some of them constitute important by-catches of demersal and benthic fisheries and are predators of commercial

species (ROPES, 1969; CHOY, 1986; ABELLÓ & CARTES, 1987; MORI, 1987). Foregut contents of *M. tuberculatus* have so far only been studied in the Ligurian Sea (MORI, 1987).

The present work was undertaken to study the feeding ecology of *M. tuberculatus* in the trawling grounds off the Catalan coasts (NW Mediterranean), in order to examine its role within the demersal ecosystem of the area.

## MATERIAL AND METHODS

Crabs were collected monthly from February to December 1984 using a bottom trawl of 18 mm cod end mesh size near Barcelona (NE Spain) within the depth range 146-420 m. All trawls were taken during daylight. Crabs were placed on ice immediately after collection and were deep-frozen within 1-3 h. Sex, size (carapace length in mm measured between the right frontal sinus and the posterior edge of the carapace: c.l.) and moult stage of each individual were recorded later.

The foregut was dissected and preserved in 70° ethanol. An estimate of foregut fullness was assigned to each foregut: (1) empty or near empty (<25% full); (2) partially full (25-49%); (3) full (50-74%), and (4) very full (>75%). Five moult stages were assigned: (1) immediate post-moult, (2) post-moult, (3) advanced post-moult, (4) intermoult, and (5) pre-moult (ABELLO, 1989).

A total of 130 crabs in degrees 3 and 4 of foregut fullness (i.e. with full or very full foreguts) were examined for prey contents (83 males and 47 females). Sizes ranged between 14 and 31 mm c.l. in males, and between 17 and 27 mm c.l. in females. Foregut contents were examined with a binocular microscope, and the different prey items were identified to the lowest possible taxonomic level. The occurrence of many of the prey types in foregut contents could very often be established only from body fragments, limiting the quantitative expression of the contents. Hence, broad taxonomic groups were categorized and the results were expressed using the frequency of occurrence method, this being most appropriate for the description of natural diet in portunid crabs (WILLIAMS, 1981). Data were collected on moult stage and degree of foregut fullness in 1403 individuals.

To test for differences in the proportional constitution of foregut contents of males and females, a chi-squared test was performed on the frequency of occurrence of the different prey categories (WEAR & HADDON, 1987; SIEGEL & CASTELLAN, 1988). Low densities of crabs in the area limited the number of crabs with full foreguts that could be examined. Samples were therefore analysed by season to look for differences in diet composition.

## RESULTS

### A) Effect of moult stage on foregut fullness

Crabs having very recently moulted accounted for the highest proportion of empty foreguts (fig. 1); no individuals were found with full foreguts (degrees 3 and 4). The highest

proportion of degree 4 (i.e. very full) foreguts was found in post-moult individuals when calcification begins (moult stage 2). The highest proportion of degree 3 and 4 foreguts (i.e. full and very full) was found in advanced post-moult individuals. Around 23% of crabs in intermoult had full or very full foreguts (degree of fullness 3 and 4). No evidence of a decrease in the proportion of foregut fullness degrees 3 and 4 was detected in pre-moult individuals.

### B) Diet analysis

It was not always possible to identify foregut material to the species level because of their fragmented and partly digested nature. Since soft-bodied animals may be underrepresented, broad taxonomic groups were used for all analyses. No significant difference in diet composition between the sexes was found ( $\chi^2 = 8.32$ ;  $p > 0.05$ ); data were therefore combined for both sexes (table 1).

Crustaceans constituted the most important prey of *M. tuberculatus*, based on presence/absence data. They were found in over 72% of the foreguts examined. Several species were identified among prey: the pelagic sergestid shrimps *Sergia robusta* (Smith) and *Sergestes arcticus* Kroyer, the pelagic shrimp *Pasiphaea sivado* (Risso), the nektobenthic shrimp *Processa canaliculata* Leach, and the benthic burrowing shrimp *Alpheus glaber* (Olivi). Unidentified euphausiids, decapods and amphipods also constituted part of the diet.

Echinoderms and fish were also commonly observed, but not in the numbers found for crustaceans (over 18% and 10%, respectively). Foraminiferans were quite often found in foreguts (over 24%). However, their role in the diet remains unclear. Polychaetes and bivalves were poorly represented (around 9% and 2%, respectively). Among the fish, *Callyonimus maculatus* Rafinesque (family Callyonimidae), a small-sized common inhabitant of the muddy bottoms in the area, was the only species that could be identified. Most fish remains in the foregut contents were of small-

sized individuals, as stated by the size of the vertebrae and other bones and by the size and shape of the otoliths. Other prey groups (including unidentified items) occurred occasionally.

Crustaceans were the most important type of prey throughout the year, according to presence/absence data (table 2). The proportion of crustaceans ingested decreased in autumn, with fish accounting for a greater proportion. However, fish did not constitute an important prey in the remainder of the year. Polychaetes were scarce in spring and summer samples. The proportion of echinoderms ingested was low and did not vary substantially throughout the year.

## DISCUSSION

The present study shows that *M. tuberculatus* probably behaves as an opportunistic predator especially on epifaunal mobile organisms, such as decapod and euphausiid crustaceans

and small fish, with infaunal or slow-moving organisms (e.g. echinoderms, polychaetes or bivalves) accounting for only a small percentage of prey occurrences.

Cessation of feeding in recently moulted crabs and its increase over intermoult values when the crab begins to harden the carapace has also been detected in other portunid crabs (ROPES, 1969; WILLIAMS, 1982; ABELLÓ & CARTES, 1987), and may be a consequence of the crabs' need to quickly reconstitute muscle tissue degenerated prior to ecdysis, as well as to properly harden the carapace. Feeding must also cease in advanced premoult individuals, as foreguts, being of ectodermic tissue, are also shed during ecdysis. However, this fact could not be clearly observed in the present study, probably due to the duration of the pre-moult stage, which made it difficult to accurately differentiate advanced pre-moult individuals ready to ecdysis from the rest of pre-moult individuals.

Foregut fullness estimates may reflect the foraging activity of *M. tuberculatus* during day-

Fig. 1. Degree of foregut fullness in relation to moult stage in the portunid crab, *Macropipus tuberculatus*. Moulting stages: 1. Immediate post-moult (n = 7); 2. Post-moult (n = 37); 3. Advanced post-moult (n = 140); 4. Intermoult (n = 1197); 5. Pre-moult (n = 22). Degree of foregut fullness: 1. Empty; 2. Partially full; 3. Full; 4. Very full.

Grado de repleción estomacal en relación con el estado de muda en el braquiuro portúnido *Macropipus tuberculatus*. Estado de muda: 1. Inmediata post-muda (n = 7); 2. Post-muda (n = 37); 3. Post-muda avanzada

(n = 140); 4. Intermuda (n = 1197); 5. Pre-muda (n = 22). Grado de repleción estomacal: 1. Vacío, 2. Parcialmente lleno, 3. Lleno, y 4. Muy lleno.

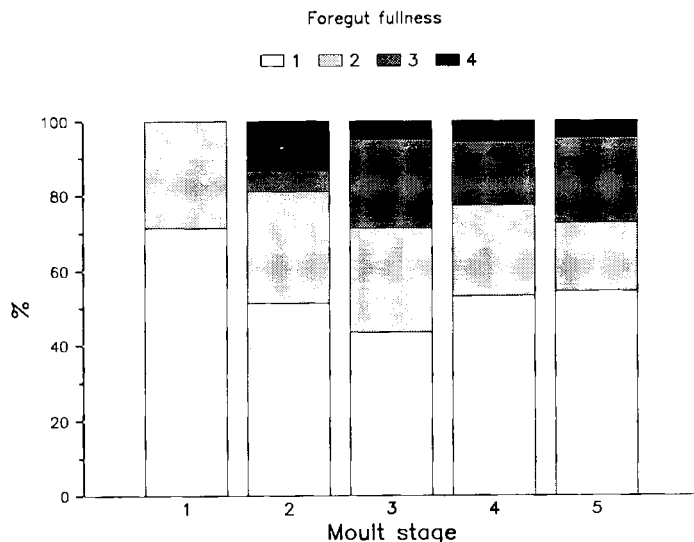


Table 1. Number and percentage of occurrence of different prey groups in male and female *Macropipus tuberculatus*.

*Número y porcentaje del número de presencias de los distintos grupos de presas en machos y hembras de Macropipus tuberculatus.*

	Males		Females		Total	
	No.	%	No.	%	No.	%
Crustaceans	54	65.1	40	85.1	94	72.3
Foraminiferans	19	22.9	13	27.7	32	24.6
Echinoderms	18	21.7	6	12.8	24	18.5
Fishes	10	12.0	4	8.5	14	10.8
Polychaetes	11	13.3	1	2.1	12	9.2
Cephalopods	2	2.4	1	2.1	3	2.3
Bivalves	3	3.6	0	0.0	3	2.3
Others	14	16.9	5	10.6	19	14.6
Number of crabs	83		47		130	

time hours. No data on activity patterns of *M. tuberculatus* are available. However, activity may increase during the night, as has been shown for related infralittoral crab species (PATTERSON, 1984). Low densities of *M. tuberculatus* in the area (ABELLO et al., 1988), and the time samples were taken, may affect the number of individuals found with full foreguts.

Most crustaceans identified as *M. tuberculatus* prey were pelagic species showing vertical migratory day-night movements, such as *Sergia robusta*, *Sergestes arcticus*, *Pasiphaea sivado* and euphausiids. *M. tuberculatus* is

accordingly involved to some degree in the mechanisms of energy transfer from the pelagic to the benthic system. Quantification is however difficult and may be too speculative based on the actual data collected (prey presences and absences).

Diets of temperate marine crabs change markedly according to different seasonal availabilities of prey (LAUGHLIN, 1982; CHOY, 1986; ABELLÓ & CARTES, 1987). The clear increase in occurrence of small fish in foregut contents in autumn samples may be attributed to the settlement of demersal juvenile fish, as most

Table 2. Seasonal percentage occurrence of different prey groups in *Macropipus tuberculatus*.

*Distribución estacional de los distintos grupos de presas (en porcentaje del número de presencias) en Macropipus tuberculatus.*

	Winter	Spring	Summer	Autumn
Crustaceans	68.1	70.0	85.0	53.8
Foraminiferans	31.9	20.0	22.5	15.4
Echinoderms	17.0	13.3	22.5	23.1
Fishes	8.5	10.0	7.5	30.8
Polychaetes	17.0	3.3	0.0	23.1
Cephalopods	0.0	3.3	5.0	0.0
Bivalves	6.4	0.0	0.0	0.0
Others	21.3	16.6	5.0	15.4
Number of crabs	47	30	40	13

shelf and upper slope fish in the western Mediterranean spawn in spring or summer (MARINARO, 1971). Thus, recruitment in some demersal fish species may be highly affected by crab predation.

Percentage occurrence of crustaceans in this study showed similar values to those observed in the Ligurian Sea (MORI, 1987). The differences in diet composition between the two Mediterranean populations may well reflect differences in prey species availability in the two areas, especially for echinoderms and other benthic organisms. This agrees with other data on portunid crabs suggesting they are not specialised organisms, but mainly opportunistic predators and scavengers (WARNER, 1977; CHOY, 1986).

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## RESUMEN

*Alimentación de Macropipus tuberculatus (Brachyura, Portunidae) en las costas catalanas (Mediterráneo NO).*

El estudio de contenidos estomacales del braquiuro portúnido *Macropipus tuberculatus* ha indicado que esta especie actúa como un depredador oportunista de crustáceos epibentónicos y pelágicos y de peces de pequeño tamaño. Organismos de la infau-na, tales como equinodermos, poliquetos y bivalvos constituyen una menor parte de la dieta. Crustáceos decápodos de hábitos pelágicos son depredados durante el día, cuando sus poblaciones se encuentran sobre el fondo o en aguas muy próximas a él. No se han detectado diferencias significativas entre los sexos en la composición de la dieta. Los individuos en inmediata post-muda mostraron la mayor proporción de estómagos vacíos, mientras que los individuos en post-muda avanzada mostraron la mayor proporción de estómagos llenos. Las diferencias estacionales halladas en la composición alimentaria se atribuyen a una variación paralela en la disponibilidad de presas en el ambiente, especialmente en lo concerniente a la presencia de juveniles de peces teleosteos.

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